CP, CKM, Electroweak Model, QCD and Cross Sections

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PDG Advisory Meeting

LBNL, Sept. 24, 2004

- Electroweak Model and Constraints on New Physics (Rev) – J. Erler(U. Mexico) and P. Langacker (U. Penn)
- Quantum Chromodynamics (Rev) – I. Hinchliffe (LBNL)
- Cross-Section Formula for Specific Processes (New) – R. Cahn (LBNL)
- CP Violation in Meson Decays (Rev) – D. Kirkby (UC Irvine) and Y. Nir(Weizmann Inst.)
- The CKM Quark-Mixing Matrix (New) – A. Ceccucci(CERN), Z. Ligeti(LBNL), Y. Sakai(KEK)

Overseers:

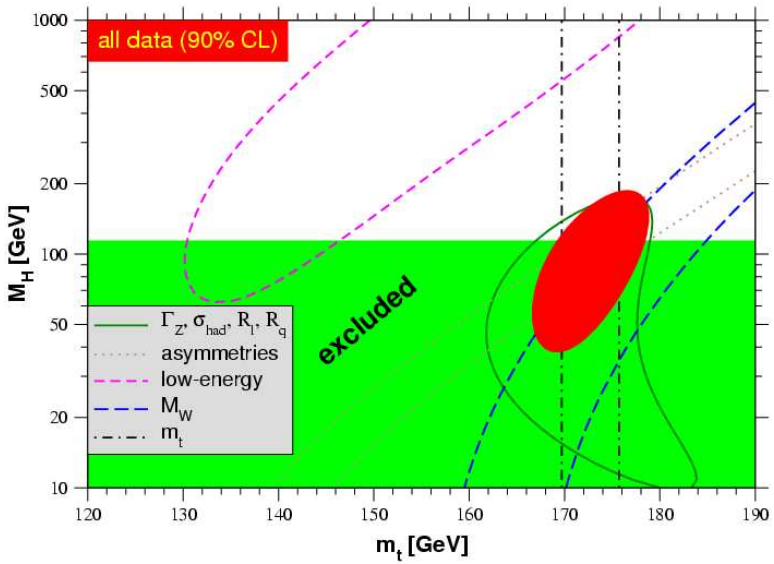
M. Barnett and W. Yao

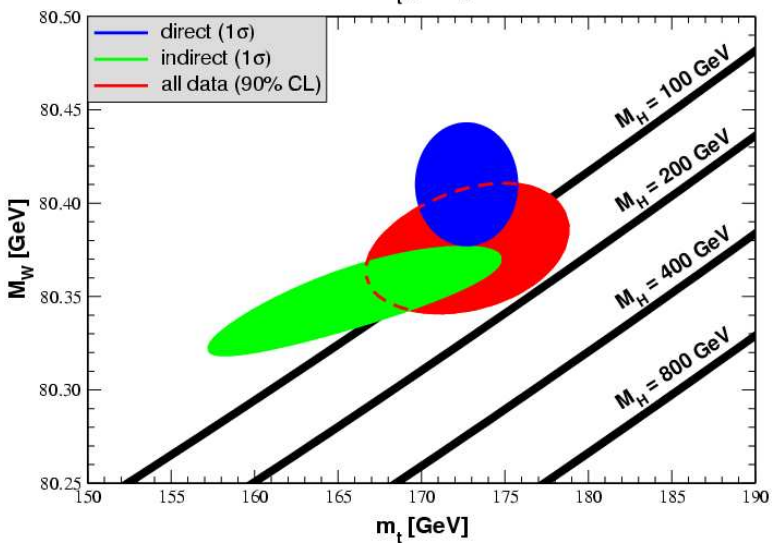
General Remarks

- These are important reviews and have been with RPP for many editions
- Authors have done an excellent job to keep the content current.
- All reviews are sent out to a few referees for comments for every edition.
- The refereeing is an open process where the names of the referees are known to the authors and direct correspondence is encouraged.
- Last year, following the PDG advisory committee's recommendation, we have successfully commissioned the new CKM review from scratch with complete new set of authors.
- The only issue we have is that these reviews are too long to fit in the booklet.
- This year, we have to cut these reviews very hard for the booklet.
- If nobody complains, the solution would be permanent.

Electroweak Model and Constrains on New Physics

- Introduction
- Renormalization and radiative corrections
- Cross-section and asymmetry formulas
- Precision flavor physics ($b \to s\gamma$, τ, $g_\mu - 2$)
- W and Z decays
- Experimental results
- Constrains on new physics





- $M_H = 89^{+38}_{-28}$ GeV/c^2 or $114.4 < M_H < 191$ GeV/c^2 at 95% C.L.

Quantum Chromodynamics

- The QCD Lagrangian
- The QCD coupling and renormalization scheme
- QCD in deep-inelastic scattering
- QCD in decays of the τ lepton
- QCD in high-energy hadron collisions
- QCD in heavy-quarkonium decay
- Perturbative QCD in e^+e^- collisions
- Scaling violation in fragmentation functions
- Photon structure functions
- Jet rates in ep collisions
- QCD in diffractive events
- Lattice QCD
- Conclusions

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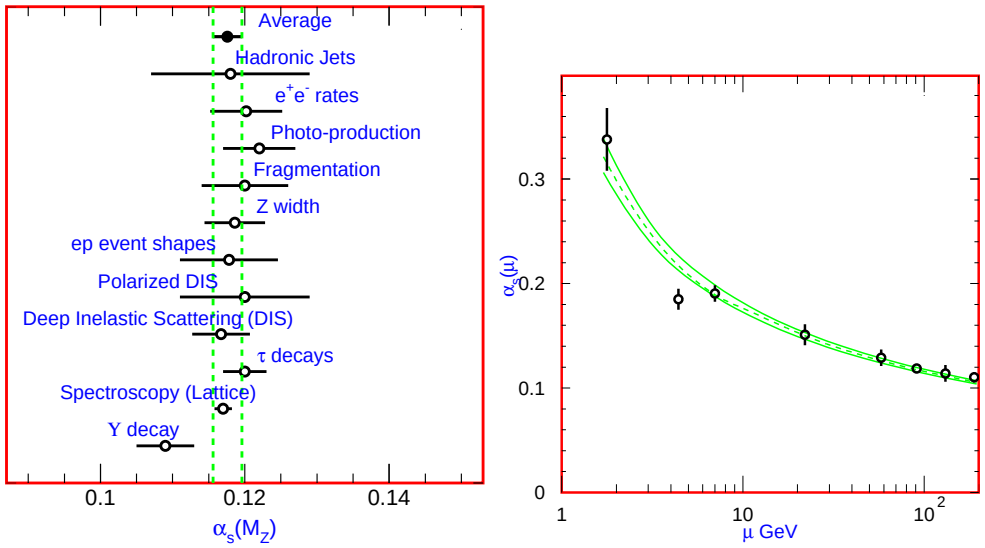

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- $\alpha_s(M_Z) = 0.1176 \pm 0.002$
- Clearly shows the experimental evidence for α_s running

Cross-Section Formula for Specific Processes

- Resonance Formation
- Production of light particles
- Production of Weak Gauge Bosons
  - W and Z resonant production
  - Production if pairs of weak gauge bosons
- Production of Higgs Bosons
  - Resonant Production
  - Higgs Boson Production in W^* and Z^* decay
  - W and Z Fusions
- Inclusive hadronic reactions
- Two-photon processes

- Following the PDG advisory committee's recommendation, we have implemented some of suggestions, but not all.
- The author feels strongly that the formula should be focused on the standard model processes, not hypothesized ones.
- We may have to find a co-author who is familiar with SUSY and willing to work on the missing pieces.

CP Violation In Meson Decays

- Introduction
- Formalism
  - Charged- and neutral-meson decays
  - Neutral-meson mixing
  - CP-violating observables
  - Classification of CP-violating effects
- Theoretical Interpretation:
  - General Consideration
  - The KM Mechanism
- K Decays
- D Decays
- B and B_s Decays
- Summary and Outlook

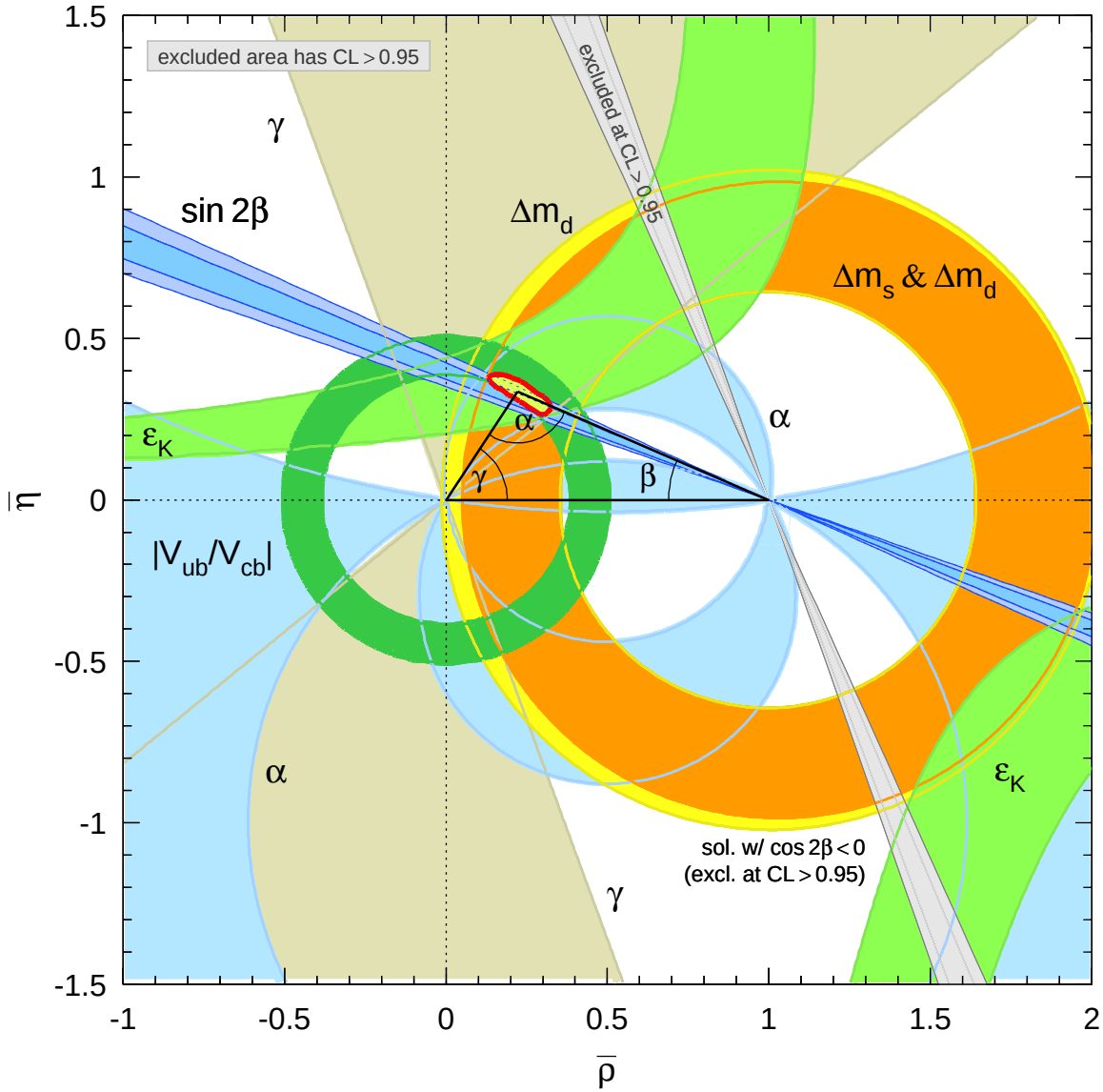
- Excellent review for CPV physics
- Minor reversion this time

The CKM Quark-Mixing Matrix

- Introduction
- Magnitudes of CKM elements
  - $|V_{ud}|$, $|V_{us}|$
  - $|V_{cd}|$, $|V_{cs}|$
  - $|V_{cb}|$, $|V_{ub}|$
  - $|V_{td}|$, $|V_{ts}|$, $|V_{tb}|$
- Phases of CKM elements
  - ϵ, ϵ'
  - β/ϕ_1
    - Charmonium modes
    - Penguin dominated modes
- Phases of CKM elements (Cont')
  - α/ϕ_2
    - $B \to \pi\pi$
    - $B \to \rho\rho$
    - $B \to \rho\pi$
  - γ/ϕ_3
    - $B^{\pm} \to DK^{\pm}$
    - $B \to D^{(*)\pm}\pi^{\mp}$
- Global fit in the Standard Model
- Implications beyond the SM

- The authors have written most comprehensive review of CKM elements to date.
- The referee's comments are positive with some suggestions which the authors implemented.

CKM Fit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γ
sin 2β
Δm_d
Δm_s & Δm_d
α
ε_K
α
γ
β
|V_ub/V_cb|
α
ε_K
sol. w/ cos 2β < 0
(excl. at CL > 0.95)
γ
1.5
1
0.5
0
-0.5
-1
-1.5
-1
-0.5
0
0.5
1
1.5
2
η̄
ρ̄